

Evaluation of Dessert Banana (*Musa spp.*) Cultivars for Growth, Phenological, Yield and Yield Components at Raya Azebo Districts of Tigray Region, Northern Ethiopia

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Article history: submitted: November 10, 2021; accepted: February 24, 2022; available online: February 28, 2022

Abstract. The experiment was carried out to investigate the performance of dessert banana cultivars at Raya Azebo with the aim of selecting well adaptable and high yield banana cultivar/s. To achieve the goal of the study, the experiment was laid out in randomized complete block design and replicated thrice. From the experiment, different growth, phenological, yield, and yield-related data were collected, and analyzed using SAS software version 9.3. Dwarf Cavendish cultivar flowered earlier (549.70 days). The maximum number of days (627.20) from planting to fruit setting was recorded on Ducase Hybrid cultivar. Ducase Hybrid gave significantly the maximum bunch weight for the mother (21.04 kg) and daughter (24.53 kg) tree. The maximum number of hand bunch⁻¹ was recorded on Ducase Hybrid cultivar on both mother (11.31) and daughter (12.17) tree. Ducase hybrid gave significantly the maximum (357.80 qt/ha) marketable fruit yield hectare⁻¹ on the mother tree. On the daughter tree, Ducase hybrid gave significantly the highest (392.5 qt/ha) marketable fruit yield hectare⁻¹. The average of mother and daughter tree cropping cycle revealed that Ducase hybrid gave first ranked highest marketable fruit yield (375.15 qt/ha), but sensitive to wind. Williams-I gave the second ranked highest (334.95 qt/ha) marketable fruit yield hectare⁻¹. Thus, Williams-I cultivar is recommended for the local area. Further, study on water requirements and biochemical content is crucial.

Keywords: bunch weight; ducase-hybrid; dwarf cavendish; williams-I; poyo

INTRODUCTION

Banana is one of the most important tropical fruits and evolved in the humid tropical regions of Southeast Asia (Cheesman, 1947; Simmonds and Weatherup, 1990). Both bananas and plantains belong to the family Musaceae and the genus *Musa* (Cheesman, 1947). Most of the cultivated bananas came from inter- and intraspecific crosses between two diploid ($2n = 2x = 22$) wild species, *Musa acuminata* and *Musa balbisiana* (Pollefeys *et. al.*, 2004). The genome constitution of *Musa acuminata* is AA while *Musa balbisiana* has BB genome.

Banana represents the world's second largest fruit crop with an annual production of 116,781,658 metric tons (FAOSTAT, 2019). Furthermore, bananas and plantains are the world 4th prominent agricultural crop following rice, wheat, and maize (INIBAP, 1992; Ganapathi *et al.*, 1999) and considered as one of the most important sources of energy and starch (Onwuka and Onwuka, 2005).

It's produced throughout the year and considered as one of the most important foods in Africa. It is a primary food and cash crop for over 30 million people in East Africa (Viljoen, 2010). Banana is now a major food crop in Africa estimated to meet more than a quarter of the food energy requirements in the continent (Robinson, 1996). Furthermore, bananas and plantains are rich in starch, sugar, vitamins C, potassium, calcium, sodium, and magnesium (Wall, 2006; Doymaz, 2010).

In Ethiopia, more than 1.61 thousand hectares of land is occupied by fruit crops, and banana takes 59.43% of this area (CSA (Central Statistical Agency), 2021). In Ethiopia, the major banana producing regions are Southern, Oromia and Amhara regions (MoA (Ministry of Agriculture), 2011). In addition to providing food and nutrition security, bananas play an important role in income generation, export market, employment opportunities, feed for animals, stabilizing the environment, providing shade and increasing aesthetic appeal of landscapes (CSA, 2018).

Despite all these facts, the overall production, productivity, quality and per capita consumption of bananas in Ethiopia is very low compared to Africa and global yield levels. CSA (2021) reported the average yield of bananas in Ethiopia is 9.40 tons/ha, which is 62.32 % far lower than the average yielding of the world 20.00 tons/ha (FAO (Food and Agricultural Organization), 2017).

The low productivity is attributed to lack of recommended high yielding banana cultivars as per agro-ecology, and shortage of improved cultivar. In order to boost productivity, introduction and evaluation of registered commercial dessert banana cultivars are needed as there may be differences among dessert banana cultivars on growth and performance. Thus, the objective of the experiment is:

To evaluate the performance of commercial banana cultivars under Raya Azebo condition of Tigray region, and to select high yielding and quality fruit producing cultivar/s for growers.

METHODS

Description of Experimental area

An experiment was conducted at Mehoni Agricultural Research Center (MhARC) testing site specifically Fachagama in the Raya Azebo Woreda Northern Ethiopia. The area is located at 668 Km north to the capital city of the country. Geographically, the experimental site is located at 12° 41'50" North latitude and 39° 42'08" East longitude with an altitude of 1578 m.a.s.l. Data from the meteorological class of the center shows, mean annual rainfall of 539.32 mm with an average minimum and maximum temperature of 12.81 and 23.24°C, respectively. The soil textural class of the experimental area was clay loam with pH 7.9.

Experimental procedure

Description of experimental Material and Design

Sword suckers of eight dessert banana cultivars such as William-I, Grand Neigh, Dwarf Cavendish, Giant Cavendish, Ducase hybrid, Robusta, and Butuza were brought from Melkassa Agricultural Research Center

for investigation. The treatments were laid out in completely randomized block design (RCBD) and replicated three times. The plot size of 7.5 m length and 5 m width was used, and the spacing between blocks, plots and both rows and plants were 3 m, 2 m, and 2.5 respectively.

Site preparation, planting and management

The site for the planting was cleaned, ploughed and leveled properly. Planting holes were prepared at a size of 60*60*60 cm one month ahead of transplanting and top and sub soils were separately placed while digging. Transplanting of an appropriate suckers (sword suckers) was made during the rainy season on the already prepared planting holes. Meanwhile of transplanting, planting holes were fulfilled using the top soil at the first, then, the sucker inserted into and the sub-soil turned to the hole and pressed properly. Agronomic practices like cultivation, weeding, and other management practices: removal of dried leaves, sucker pruning, deflowering, and dehanding, were done at standard time.

Data collected

Plant growth data like plant height at fruit setting, (PHFS), number of green leaves at fruit setting (NGLFS), and girth circumference at fruit setting (GCFS = 30 cm up from the ground) were collected. Phenological data: days from planting to inflorescence (DTI), days from planting to flowering (DTF), days from planting to fruit setting (DFS), days from planting to harvest (DFPTH) for the mother tree, and days from flowering to harvest (DFFTH) for the mother tree were also collected. Yield and yield component data such as bunch weight (WtB), number of hands bunch⁻¹ (NHPB), weight of third hand (W3H), weight of single fruit (WtSF), fruit length (FL), fruit diameter (FD), and marketable yield quintal hectare⁻¹ (MrY (qt/ha) were calculated. To determine the weight of single finger, fruit diameter and length, eight fruits from the representative hand (third hand) were taken and measured, then the average of the were taken.

Statistical analysis

Statistical analysis was performed using SAS software (version 9.3). Based on the ANOVA results, mean separation was performed by the least significant difference test at 5% probability level.

RESULTS AND DISCUSSION

Plant growth Traits

Plant Height (cm)

ANOVA indicated that plant height at fruit setting was significantly ($p < 0.01$) influenced by dessert banana cultivars on the mother tree (Table 5). Significantly higher plant height (277.90 cm) was observed on Ducase hybrid cultivars for both mother (277.90 cm) and daughter (288.80 cm) tree cropping cycle. However, Ducase hybrid is non-significantly followed by Robusta (239.30 cm), Poyo (237.80 cm) and Butuza (236.90 cm) cultivars on mother tree. Regardless of their magnitude difference, ducase hybrid is significantly the same with the above three cultivars and Giant Cavendish. While, significantly the lowest plant height was recorded on Dwarf cavendish on both mother (159.10 cm) and (166.4 cm) trees (Table 1). Regardless of the similarity of cultivars under study and their performance, plant height was significantly influenced by cultivars (Binalfew and Damtew, 2015). This might be due to variation in genetic constituent which makes them different in the degree of growth, phenological appearances yield and yield components.

Number of Green leaves

On both mother and daughter trees, number of green leaves at fruit setting are significantly ($p < 0.05$) affected by banana cultivars (Table 5). Similar to plant height, Ducase hybrid gave significantly the maximum number of leaves on daughter

(14.00) (Table 1). Giant cavendish gave significantly the maximum (14.44) number of green leaves at fruit setting on mother tree, followed by Ducase hybrid (14.42), William-I (10.41) and Grand naih (9.83) cultivars. However, the lowest (8.90) number of green leaves at fruit setting is recorded on Butuza cultivar on the mother tree, which is significantly the same with all the cultivars except Ducase hybrid and Giant cavendish. On the daughter tree cropping cycle, the lowest number of green leaves at fruit setting was recorded on Poyo (8.07) cultivar, which is significantly the same with Grand naih, Giant cavendish, Robusta and Butuza cultivars (Table 1).

Binalfew and Damtew (2015) reported that the number of leaves were significantly influenced by dessert banana cultivars. This might be related to the variability of banana cultivars in retaining their leaves green after fruit setting.

Girth Circumference (cm)

Dessert banana cultivars exerted highly significant difference ($p < 0.01$) on girth circumference at fruit setting stage on both mother and daughter trees (Table 5). Ducase hybrid gave significantly the maximum girth circumference at fruit setting on both mother (83.14 cm) and daughter (84.75 cm) tree cropping cycle. The rest all cultivars are significantly the same with each other and considered and the lowest on daughter tree cropping cycle.

On the mother tree, Butuza gave significantly the lowest (58.22 cm) girth circumference at fruit setting, which is significantly the same with Dwarf cavendish, Giant Cavendish, Robusta and Poyo cultivars (Table 1). In line with this, Binalfew and Damtew (2015) reported that pseudostem girth and plant height were significantly influenced by dessert banana cultivars.

Table 1. Mean of growth characters of dessert banana cultivars

Cultivars	PHFS (cm)		Mean	NGLFS		Mean	GCFS (cm)		Mean
	Cropping Cycle			Cropping Cycle			Cropping Cycle		
	Mother	Daught.	Mother	Daught.	Mother	Daught.			
Grand Naih	210.8 ^b	212.7 ^c	211.75	9.83 ^{ab}	9.36 ^{bc}	9.60	68.28 ^b	68.31 ^b	68.30
Williams-I	207.00 ^b	218.3 ^{bc}	212.65	10.41 ^{ab}	11.00 ^b	10.71	69.68 ^b	69.25 ^b	69.50
Poyo	237.80 ^{ab}	264.3 ^a	251.05	9.67 ^b	8.07 ^c	8.87	63.72 ^{bc}	65.00 ^b	64.36
G. Cavendish	233.20 ^b	252.1 ^{ab}	242.65	14.44 ^a	9.91 ^{bc}	12.18	64.33 ^{bc}	67.18 ^b	65.76
Robusta	239.30 ^{ab}	267.4 ^a	253.35	9.39 ^b	10.00 ^{bc}	9.70	64.11 ^{bc}	65.67 ^b	64.89
D. Cavendish	159.10 ^c	166.4 ^d	162.75	9.61 ^b	10.33 ^b	9.97	66.61 ^{bc}	66.67 ^b	66.64
D. Hybrid	277.90 ^a	288.8 ^a	283.35	14.42 ^a	14.00 ^a	14.21	83.14 ^a	84.75 ^a	83.95
Butuza	236.9 ^{ab}	258.1 ^a	247.5	8.90 ^b	9.67 ^{bc}	9.29	58.22 ^c	65.78 ^b	62
Mean	225.26	241.03		10.83	10.29		67.26	69.07	
LSD (0.05)	41.27	37.98		4.61	2.00		8.58	9.46	

Means within columns followed by different letter (s) for each variable are significantly different at ($p < 0.05$). PHFS = Plant height at fruit setting, NGLFS = Number of green leaves at fruit setting, GCFS = Girth circumference at fruit setting

Phenological Characters

Days to Inflorescence

Days to inflorescence from planting was not significantly ($p \geq 0.05$) affected by dessert banana cultivars on both mother and daughter trees (Table 5). However, Poyo cultivar staid a greater number of days (518.80 days) to commence inflorescence on mother tree cropping cycle. While, Grand naih cultivar bears inflorescence earlier (448.20 days) than the other dessert banana cultivars on the mother tree cropping cycle. The average data of the mother and daughter tree cropping cycle indicated that Giant Cavendish started bearing inflorescence earlier (49.90 days) than the other cultivars numerically, while, Poyo staid longer (546.00 days) to commence inflorescence (Table 2).

Days to Flowering

Days from planting to flowering was statistically significantly ($p < 0.05$) affected by dessert banana cultivars on the daughter tree, but not significantly ($p \geq 0.05$) affected by dessert banana cultivars on mother trees

(Table 6). Ducase Hybrid was late flowered (615.50 days) cultivar which is non significantly followed by William-I (595.40 days), Grand Naih (594.40 days), Butuza (589.20 days), Robusta (587.60 days) and Poyo (583.00 days) cultivars. Dwarf Cavendish cultivar was flowered earlier (549.70 days).

Days to Fruit setting

Days from planting to fruit setting was significantly ($p < 0.05$) affected by dessert banana cultivars on the daughter tree, but not significantly ($p \geq 0.05$) affected by dessert banana cultivars on mother trees (Table 6). Significantly the maximum number of days (627.20) to fruit setting was recorded on Ducase Hybrid cultivar, which is significantly similar with all varieties except Dwarf and Giant Cavendish cultivars which were fruit set earlier with average number of days 560.80 and 569.80 respectively (Table 2).

Days from Planting to Harvesting and Days from flowering to Harvesting

The number of days from planting to harvesting was not significantly ($p \geq 0.05$) affected by dessert banana cultivars on both mother and daughter trees (Table 6). Also, the number of days from flowering to harvesting was not significantly ($p \geq 0.05$) affected by dessert banana cultivars on both mother and daughter trees (Table 6). Numerically, the highest number of days (668.70 days) from planting to harvest was recorded on Poyo cultivar, while the lowest number of days (624.00) from planting to harvesting was noted on Giant Cavendish cultivar (Table 2). Thus, Poyo cultivar needs a greater number of days till harvesting, although Giant Cavendish is considered as an earlier cultivar.

Williams-I needs a minimum number of days (123.70 days) from flowering to harvesting. However, Grand naih staid longer (182.00) once bear flower till harvesting (Table 2). This means, Grand naih staid a greater number of days to be harvested, while, William-I attained harvesting stage within almost four months once flowered.

Yield and Yield Components

Bunch Weight (kg)

Banana cultivars exerted a significant difference ($p < 0.05$) on bunch weight for mother tree, but not for daughter tree (Table 7). Ducase Hybrid gave significantly the maximum (21.04 kg) bunch weight which is

significantly the same with all the other cultivars except Butuza which gave the lowest (12.64 kg) bunch weight on the mother tree. However, Butuza which gave the lowest bunch weight is significantly different from only William-I (20.77 kg), Robusta (20.03 kg) and Ducase Hybrid (21.04 kg) cultivar. Also, Ducase hybrid gave significantly the highest (24.53 kg) bunch weight on the daughter tree cropping cycle, which is significantly differed from Butuza (14.87 kg), Poyo (15.36kg) and Giant Cavendish (16.12 kg) cultivars. Average data of mother and daughter tree indicated that Ducase hybrid and William-I is the first and the second in the order bunch weight with mean value of 22.79 kg and 21.08 kg respectively. Butuza gave the lowest (13.76 kg) bunch weight (Table 3).

Similarly, different scholars also reported the significant difference among cultivars on bunch weight. (Aseffa *et al.*, 2020) found that average yield of bananas showed significant difference among cultivars whereby significantly the maximum yield was recorded from Dwarf Cavendish. Also, (Zewdu *et al.*, 2016) reported, Giant Cavendish gave significantly the maximum bunch weight. The variation among the cultivars on growth, yield and yield components at different location might be attributed to the difference in agroecology of the area, extent of adaptability of the cultivars and the interaction attribute of genotype with environment.

Table 2. Mean of growth and phenological characters of dessert banana cultivars

Cultivars	DTI		Mean	DTF		Mean	DFS		Mean	DFPTH	DFFTH
	Cropping Cycle			Cropping Cycle			Cropping Cycle			Cropping Cycle	
	Mother	Daughter	Mother	Daughter	Mother	Daughter	Mother	Daughter	Mother	Mother	
Grand Naih	448.20	584.4	516.3	457.4	594.4 ^{ab}	525.9	468.1	605.3 ^{ab}	536.7	634.9	182.0
Williams-I	470.00	585.3	527.65	480.3	595.4 ^{ab}	537.85	490.7	601.0 ^{abc}	545.85	642.1	123.7
Poyo	518.80	573.2	546	528.4	583.0 ^{abc}	555.7	537.5	592.2 ^{abc}	564.85	668.7	151.0
G. Cavendish	448.40	551.4	499.9	457.1	561.3 ^{bc}	509.2	466.8	569.8 ^{bc}	518.3	624.0	169.4
Robusta	464.80	578.8	521.8	476.2	587.6 ^{abc}	531.9	485.2	595.9 ^{abc}	540.55	651.2	173.3
D. Cavendish	467.60	538.0	502.8	477.8	549.70 ^c	513.75	489.4	560.8 ^c	525.1	655.3	177.4
D. Hybrid	476.20	553.2	514.7	489.5	615.50 ^a	552.5	501.2	627.2 ^a	564.2	641.8	152.3
Butuza	507.40	571.3	539.35	516.1	589.20 ^{ab}	552.65	525.6	597.8 ^{abc}	561.7	657.8	150.1
Mean	475.19	566.96		485.35	584.52		495.56	593.75		646.98	159.90
LSD (0.05)	ns	ns		ns	39.38		Ns	41.029		ns	ns

Means within columns followed by different letter (s) for each variable are significantly different at (p<0.05)

DTI = Days to inflorescence, DTF = Days to flowering, DFS = Days to fruit setting, DFPTH = Days from planting to harvest,

DFFTH = Days from flowering to harvest

Number of Hands Bunch⁻¹

Regardless of the level of significance, number of hands bunch⁻¹ were significantly ($p < 0.05$) affected by banana cultivars on mother and daughter tree (Table 7). The maximum number of hands bunch⁻¹ were recorded on Ducase Hybrid cultivar on both mother and daughter tree cropping cycle with average number of hands bunch⁻¹ of 11.31 and 12.17 respectively. While, Butuza cultivar gave the lowest hand number bunch⁻¹ on both mother (7.44) and daughter (8.00) tree and significantly the same with all the rest cultivar except the cultivar which gave the maximum hand numbers bunch⁻¹ on the mother tree. On the daughter tree, it is also significantly at par with Robusta (8.08), Poyo (8.13), Giant Cavendish and Grand naih (9.17) (Table 3).

Zewdu *et al.* (2016) reported the significance variation among dessert banana cultivars on hand number bunch⁻¹. In his case, Giant Cavendish gives higher number of hands per bunch. Also, Wassu *et al.* (2014) obtained the highest mean numbers of hands bunch⁻¹ on Williams-I and Giant Cavendish cultivar. In these cases, the significant variation among cultivars on number of hands bunch⁻¹ were repeatedly reported. However, a particular cultivar is not performing in static way. This might be due to the rationale that growth, phenology, yield and yield components of the fruit trees are varying with the agroecology, extent of adaptability of the cultivars and genetic potential.

Weight of Third Hand and Weight of Single Fruit

Weight of the third hand was statistically significantly ($p < 0.05$) influenced by banana cultivars on the mother tree, but not on the daughter tree cropping cycle (Table 7). Statistically the maximum third hand weight

(2.73kg) was observed on Robusta cultivar which is significantly the same with all the rest cultivars except Butuza which gave significantly the lowest (1.70 kg) third hand weight on the mother tree cropping cycle. Also, the average result of daughter and mother tree indicated that Robusta cultivar gave the maximum third hand weight (2.61 kg), while the lowest is obtained on Butuza cultivar with mean value of 1.94 kg (Table 3). This might be due to having a good finger size and finger number.

Also, banana cultivars exerted statistically significant difference ($p < 0.05$) on the single fruit weight (finger weight) of the mother and daughter tree cropping cycle (Table 7). Grand naih cultivar gave the highest (0.129 kg) single fruit weight on the mother tree which is statistically similar with all the cultivars except Poyo (0.045 kg) and Butuza (0.055 kg) cultivars.

The lowest single fruit weight (0.045 kg) was obtained on Poyo cultivar which is significantly the same with the investigated cultivars except Williams-I (0.126 kg) and Grand naih (0.129 kg) cultivars on the mother tree (Table 3). William-I gave significantly the maximum single fruit weight (0.23 kg) and followed by Ducase hybrid with mean value of (0.16 kg) on daughter tree (Table 3).

The finding is in line with that of Aseffa *et al.* (2020) who reported an average weight of banana finger showed significant variation among the cultivar whereby the maximum finger weight was obtained from Dwarf Cavendish cultivar. The variation of cultivar in finger weight, hand weight, bunch weight and the other growth, phenological and yield might be due to the rationale that the performance of the particular crop/cultivar is highly affected by the environment.

Table 3. Mean of yield characters of dessert banana cultivars

Cultivars	WtB (kg)		Mean	NHPB		Mean	W3H(kg)		Mean	WtSF (kg)		Mean
	Cropping Cycle			Cropping Cycle			Cropping Cycle			Cropping Cycle		
	Mother	Daughter	Mother	Daughter	Mother	Daughter	Mother	Daughter	Mother	Daughter		
Grand Naih	19.53 ^{ab}	18.17 ^{abc}	18.85	8.72 ^b	9.17 ^{bcd}	8.95	2.41 ^{ab}	2.05	2.23	0.129 ^a	0.12 ^b	0.12
Williams-I	20.77 ^a	21.39 ^{abc}	21.08	8.66 ^b	9.33 ^{bc}	9.00	2.56 ^a	2.67	2.585	0.126 ^a	0.23 ^a	0.18
Poyo	14.37 ^{ab}	15.36 ^{bc}	14.87	7.92 ^b	8.13 ^{cd}	8.03	2.13 ^{ab}	2.24	2.185	0.045 ^b	0.13 ^b	0.09
G. Cavendish	16.15 ^{ab}	16.12 ^{bc}	16.14	8.57 ^b	8.11 ^{cd}	8.34	2.29 ^{ab}	2.16	2.225	0.090 ^{ab}	0.13 ^b	0.11
Robusta	20.03 ^a	19.21 ^{abc}	19.62	7.75 ^b	8.08 ^{cd}	7.92	2.73 ^a	2.49	2.61	0.110 ^{ab}	0.14 ^b	0.13
D. Cavendish	14.25 ^{ab}	23.27 ^{ab}	18.76	8.40 ^b	10.00 ^b	9.20	1.95 ^{ab}	2.88	2.415	0.095 ^{ab}	0.13 ^b	0.11
D. Hybrid	21.04 ^a	24.53 ^a	22.79	11.31 ^a	12.17 ^a	11.74	2.23 ^{ab}	2.82	2.525	0.097 ^{ab}	0.16 ^{ab}	0.13
Butuza	12.64 ^b	14.87 ^c	13.76	7.44 ^b	8.00 ^d	7.72	1.70 ^b	2.18	1.94	0.055 ^b	0.15 ^b	0.10
Mean	17.35	19.12		8.60	9.12		2.25	2.44		0.09	0.15	
LSD (0.05)	7.30	7.99		1.77	1.28		0.83	ns		0.067	0.07	

Means within columns followed by different letter (s) for each variable are significantly different at (p<0.05)

WtB = Weight of bunch, NHPB = Number of hands bunch⁻¹, W3H = Weight of third hand, WtSF = Weight of single finger

Fruit Length and Diameter (cm)

Fruit length was not significantly ($p \geq 0.05$) affected by dessert banana cultivars on both mother and daughter cropping cycle. Dessert banana cultivars exerted significant ($p < 0.05$) difference on fruit diameter on daughter tree, but not on mother tree (Table 8). Average result of daughter and mother tree indicated that Poyo gave the longest fruit length (15.38 cm), while Grand naih gave the shortest fruit length (13.66 cm) as indicated in (Table 4). On the daughter tree, Poyo gave significantly the widest (4.01 cm) fruit diameter, followed by Ducase hybrid (3.65 cm). The mean value of mother and daughter tree cropping cycle indicated that Poyo gave the widest fruit diameter (3.75 cm). However, Butuza gave the smallest fruit diameter (Table 4). This variation might be attributed to genetic constituents of the cultivars. In agreement with this finding, Binalfew and Damtew (2015) reported that fruit diameter and length were significantly influenced by dessert banana cultivars.

Marketable Fruit Yield (qt/ha)

Marketable yield was statistically significantly ($p < 0.05$) affected by dessert banana cultivars on both mother and daughter tree cropping cycle (Table 8). Ducase hybrid gave significantly the maximum (357.80 qt/ha) marketable fruit yield hectare⁻¹, which is followed by William-I (327.70 qt/ha), Robusta (318.30 qt/ha), and Grand naih

(310.60 qt/ha) on the mother tree cropping cycle. On the same cropping cycle, the lowest marketable fruit yield (185.40) hectare⁻¹ was observed on Butuza cultivar which are significantly the same with Dwarf Cavendish (204.00 qt/ha), Poyo (236.70 qt/ha) and Giant Cavendish (238.00 qt/ha). On the daughter tree cropping cycle, Ducase hybrid gave significantly the highest (392.5 qt/ha) marketable fruit yield hectare⁻¹ with Dwarf Cavendish (372.40 qt/ha), Williams-I (342.20 qt/ha), Robusta (307.30 qt/ha) and Grand naih (290.70 qt/ha) were the successors (Table 4).

The average of mother and daughter tree cropping cycle revealed that Ducase hybrid gave first ranked highest marketable fruit yield (375.15 qt/ha), also, Williams-I gave the second ranked highest (334.95 qt/ha) marketable fruit yield hectare⁻¹. The lowest one is recorded on Butuza cultivar (211.65 qt/ha) as indicated (Table 4). The maximum yield might be attributed to the genetic potential of the cultivar/s, their adaptability to such environment, capability to produce a greater number of hands bunch⁻¹ (having a greater bunch weight), greater number of fingers bunch⁻¹ and well sized finger (diameter and length). Binalfew and Damtew (2015) reported, dessert banana showed a significant difference for yield and yield related characters, whereby the highest fruit yield was recorded from Dwarf Cavendish cultivar.

Table 4. Mean of yield and yield component of dessert banana cultivars

Cultivars	FL		Mean	FD		Mean	MrY (qt/ha)		Mean
	Cropping Cycle			Cropping Cycle			Cropping Cycle		
	Mother	Daugh.	Mother	Daugh.	Mother	Daugh.			
Grand Naih	15.79	11.53	13.66	3.63	3.31 ^{bc}	3.47	310.6 ^{ab}	290.7 ^{abc}	300.65
Williams-I	15.69	14.48	15.09	3.48	3.38 ^{bc}	3.43	327.7 ^{ab}	342.2 ^{abc}	334.95
Poyo	15.00	15.75	15.38	3.49	4.01 ^a	3.75	236.7 ^{bc}	245.8 ^{bc}	241.25
G. Cavendish	14.59	14.22	14.41	3.55	3.18 ^c	3.37	238.0 ^{bc}	258.0 ^{bc}	248.00
Robusta	15.07	14.44	14.76	3.83	3.29 ^{bc}	3.56	318.3 ^{ab}	307.3 ^{abc}	312.80
D. Cavendish	14.49	15.00	14.75	3.45	3.48 ^{bc}	3.46	204.0 ^c	372.4 ^{ab}	288.20
D. Hybrid	13.68	14.00	13.84	3.57	3.65 ^{ab}	3.61	357.8 ^a	392.5 ^a	375.15
Butuza	13.65	14.50	14.01	3.29	3.30 ^{bc}	3.30	185.4 ^c	237.9 ^c	211.65
Mean	14.75	14.24		3.54	3.45		272.31	305.85	
LSD (0.05)	Ns	ns		ns	0.431		106.51	127.907	

Means within columns followed by different letter (s) for each variable are significantly different at (p<0.05)

Daugh. = Daughter, FL = Finger length, FD = Finger Diameter, MrY (qt/ha) = Marketable yield quintal hectare⁻¹

Table 5. Mean square of growth characters of dessert banana cultivars

Source of Variation	DF	PHFS		NGLFS		GDFS		DTI	
		Cropping Cycle		Cropping Cycle		Cropping Cycle		Cropping Cycle	
		Mother	Daugh.	Mother	Daugh.	Mother	Daugh.	Mother	Daugh.
Replication	2	1611.50	103.50	6.20	3.478	34.83	5.61	18745.00	1845.9
Cultivars	7	3532.20 ^{**}	4635.10	15.32 [*]	8.873 ^{**}	159.49 ^{**}	126.35 ^{**}	1964.00 ^{ns}	901.9 ^{ns}
Error	14	555.40	470.40	6.94	1.309	24.00	29.20	1816.00	590.6
CV (%)		10.5	9.0	24.3	11.1	7.3	7.80	9.0	4.3

^{*}, and ^{**}, significant at P<0.05, p<0.01 probability levels respectively, ns= not significant, DF= Degree of freedom

Table 6. Mean square of phenological characters of dessert banana cultivars

Source of Variation	DF	DTF		DFS		DFPTH	DFFTH
		Cropping Cycle		Cropping Cycle		Cropping Cycle	Cropping Cycle
		Mother	Daugh.	Mother	Daugh.	Mother	Mother
Replication	2	18940.00	3785.3	18881.00	3479.0	15254.00	2103.00
Cultivars	7	1955.00 ^{ns}	1269.7	1903.00 ^{ns}	1282.9 ^{ns}	600.00 ^{ns}	1117.00 ^{ns}
Error	14	1861.00	505.8	1854.00	548.9	1506.00	1670.00
CV (%)		8.9	3.8	8.7	3.9	6.0	25.6

*, and **, significant at P<0.05, p<0.01 probability levels respectively, ns= not significant, DF= Degree of freedom

Table 7. Mean square of yield characters of dessert banana cultivars

Source of Variation	DF	WtB		WtSF		W3H		NHPB	
		Cropping Cycle		Cropping Cycle		Cropping Cycle		Cropping Cycle	
		Mother	Daught.	Mother	Daught.	Mother	Daught.	Mother	Daught.
Replication	2	6.97	27.10	0.0008	0.004	0.50	0.28	0.82	0.93
Cultivars	7	34.01*	40.21	0.0028*	0.003	0.33*	0.31	4.24*	6.19***
Error	14	17.35	20.84	0.0015	0.002	0.23	0.22	1.02	0.56
CV (%)		24.0	23.9	20.8	27.2	21.1	19.3	11.8	8.0

*, **and *** significant at P<0.05, p<0.01 and p<0.001 probability levels respectively, ns= not significant, DF= Degree of freedom

Table 8. Mean square of yield and yield components of dessert banana cultivars

Source of Variation	DF	FL		FD		MrY (qt/ha)	
		Cropping Cycle		Cropping Cycle		Cropping Cycle	
		Mother	Daughter	Mother	Daughter	Mother	Daughter
Replication	2	1.75	3.14	0.19	0.19728	2746.00	6937.00
Cultivars	7	1.96 ^{ns}	4.47 ^{ns}	0.07 ^{ns}	0.21426*	12263.00*	10293.00*
Error	14	1.97	13.23	0.13	0.06071	3699.00 ^{ns}	5335.00
CV (%)		9.5	25.5	10.3	7.1	22.3	23.9

*, and **, significant at P<0.05, p<0.01 probability levels respectively, ns= not significant, DF= Degree of freedom

CONCLUSION

The result obtained from an experiment revealed that plant height, bunch weight and weight of third hand, highly significantly ($p < 0.01$) influenced by dessert banana cultivars on the mother tree. On both mother and daughter trees, number of green leaves, girth circumference, number of hands bunch⁻¹, single fruit weight, fruit diameter and marketable yield hectare⁻¹ are significantly ($p < 0.05$) affected by banana cultivars. Days from planting to flowering and fruit setting were statistically significantly ($p < 0.05$) affected by dessert banana cultivars on the daughter tree.

The highest plant height (277.90 cm) was observed on Ducase hybrid cultivar for both mother (277.90 cm) and daughter (288.80) tree cropping cycle. Ducase hybrid gave significantly the maximum number of leaves on daughter (14.00) tree, while, Giant cavendish gave the maximum (14.44) on mother tree. The maximum girth circumference on mother (83.14 cm) and daughter (84.75 cm) tree was recorded on Ducase hybrid cultivar. Dwarf Cavendish cultivar was flowered earlier (549.70 days). The maximum number of days (627.20) from planting to fruit setting was recorded on Ducase Hybrid cultivar. Williams-I needs shortest number of days (123.70 days) from flowering to harvesting numerically. Ducase Hybrid gave significantly the maximum bunch weight for mother (21.04 kg) and daughter (24.53 kg) tree. The maximum number of hand bunch⁻¹ was recorded on Ducase Hybrid cultivar on both mother (11.31) and daughter (12.17) tree. The maximum third hand weight (2.73kg) was observed on Robusta cultivar. Grand naih cultivar gave the highest (0.129 kg) single fruit weight on the mother tree. On the daughter tree, Poyo gave significantly the widest (4.01 cm) fruit diameter. Ducase hybrid gave significantly the maximum (357.80 qt/ha) marketable fruit yield hectare⁻¹ on the mother tree cropping cycle. On the daughter tree cropping cycle, Ducase hybrid gave significantly the highest (392.5

qt/ha) marketable fruit yield hectare⁻¹. The average of mother and daughter tree cropping cycle revealed that Ducase hybrid gave first ranked highest marketable fruit yield (375.15 qt/ha), Also, Williams-I gave the second ranked highest (334.95 qt/ha) marketable fruit yield hectare⁻¹.

Williams-I cultivar which gave the second highest marketable yield (334.95 qt/ha) is recommended for the local area. Further, studying the water requirement and biochemical content investigation are crucial.

ACKNOWLEDGMENT

Primarily, we would like to acknowledge Almighty God for his an endless help and provided us endurances to undertake the research. Next, we would like to acknowledge our budget source for the accomplishment of the research study. Finally, our heartfelt thanks goes to Halle fom Hailu and Tedirewos Abreha for their strong participation in helping as in data collection and field management.

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